

Das Licht der Zukunft

Workshop IV - 1

23. März 2010

Bernhard Stapp



Review on the past 10 Years – a Revolution Started

Focus 2000-2010 on semiconductor light sources

Efficacy increase *lm/W*

Brightness increase *lm*

⇒ enabler for new applications:



The LED Brings Growth to the Lighting Market

Forecast for SSL applications*:

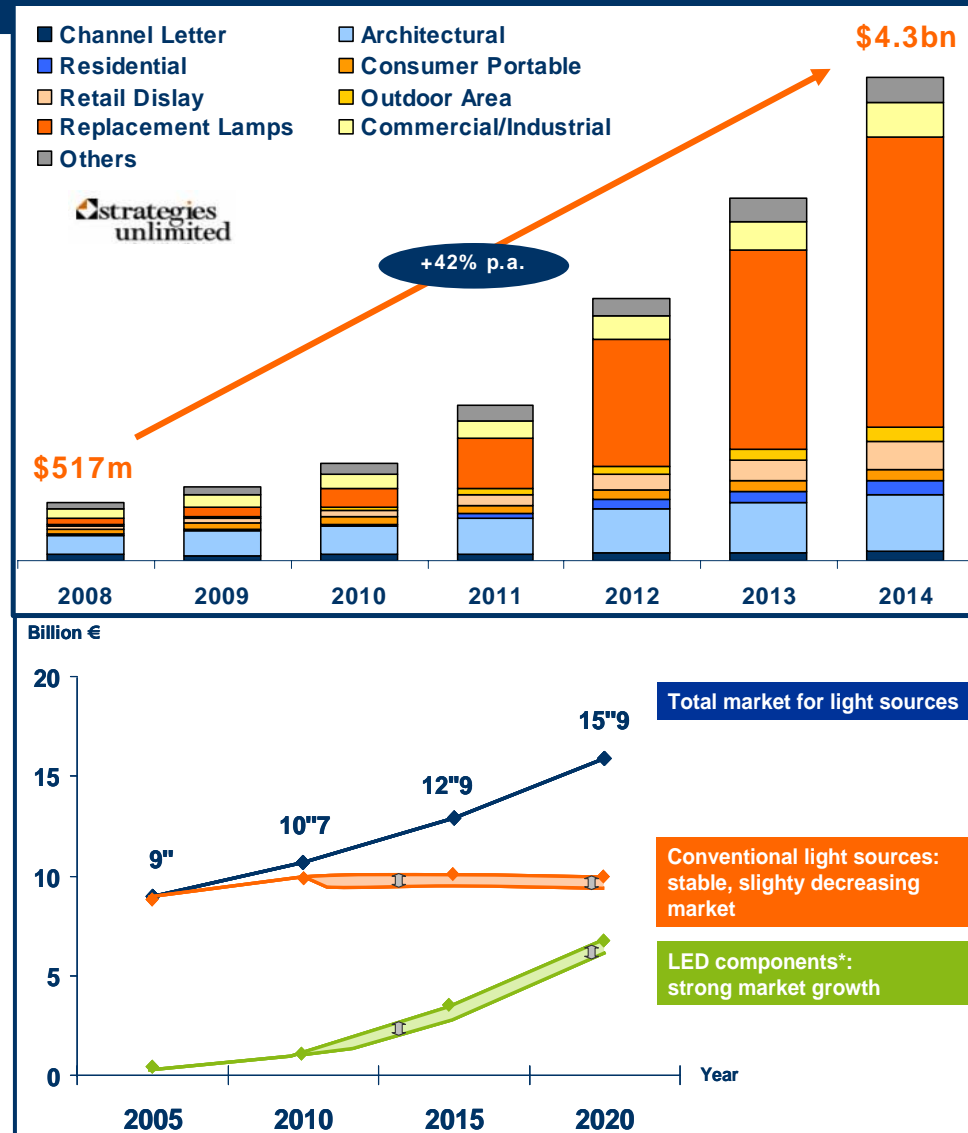
- LED replacement lamps with > 100 % CAGR
- Residential, retail and outdoor with high CAGR

Forecast for LED share of the lighting market:

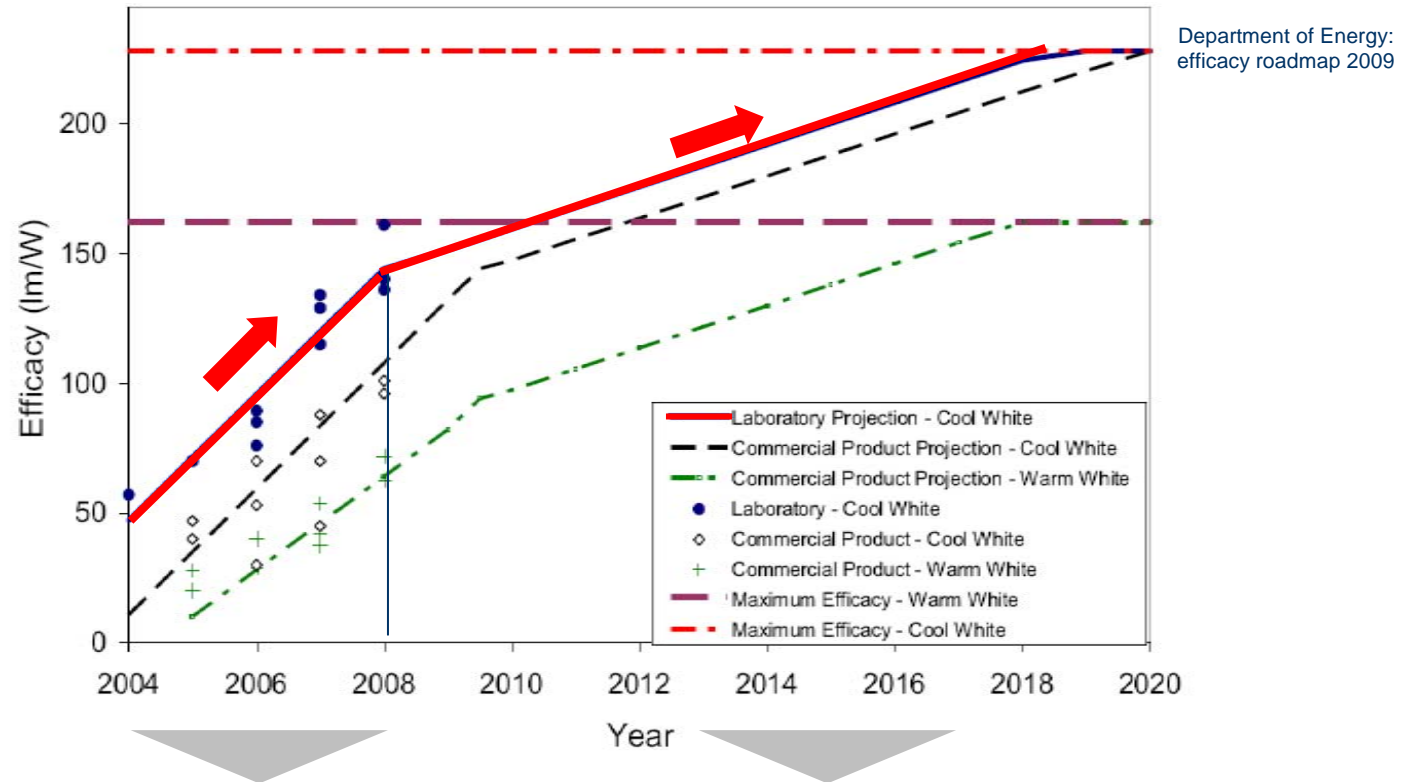
- > 40% in 2020
- other studies up to 80%**

*Strategies Unlimited, March 2010

**JP Morgen



Impressive Development of the Efficacy of White LEDs

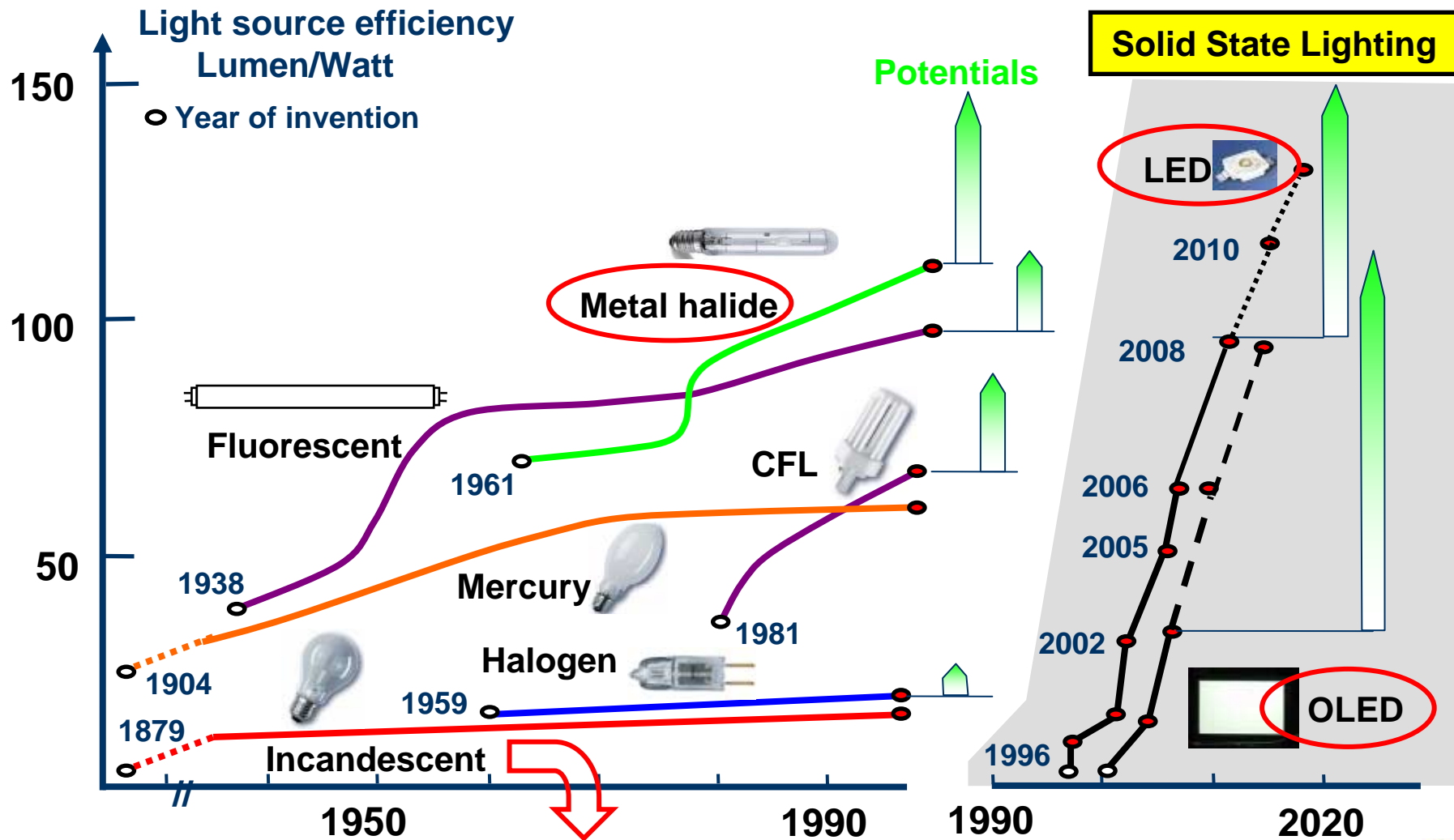


3-4 x efficacy improvement
in just 4 years

Efficacy improvement slows
down but the race continues

LEDs are now ready for general lighting

Energy Efficient Light Sources for the Future



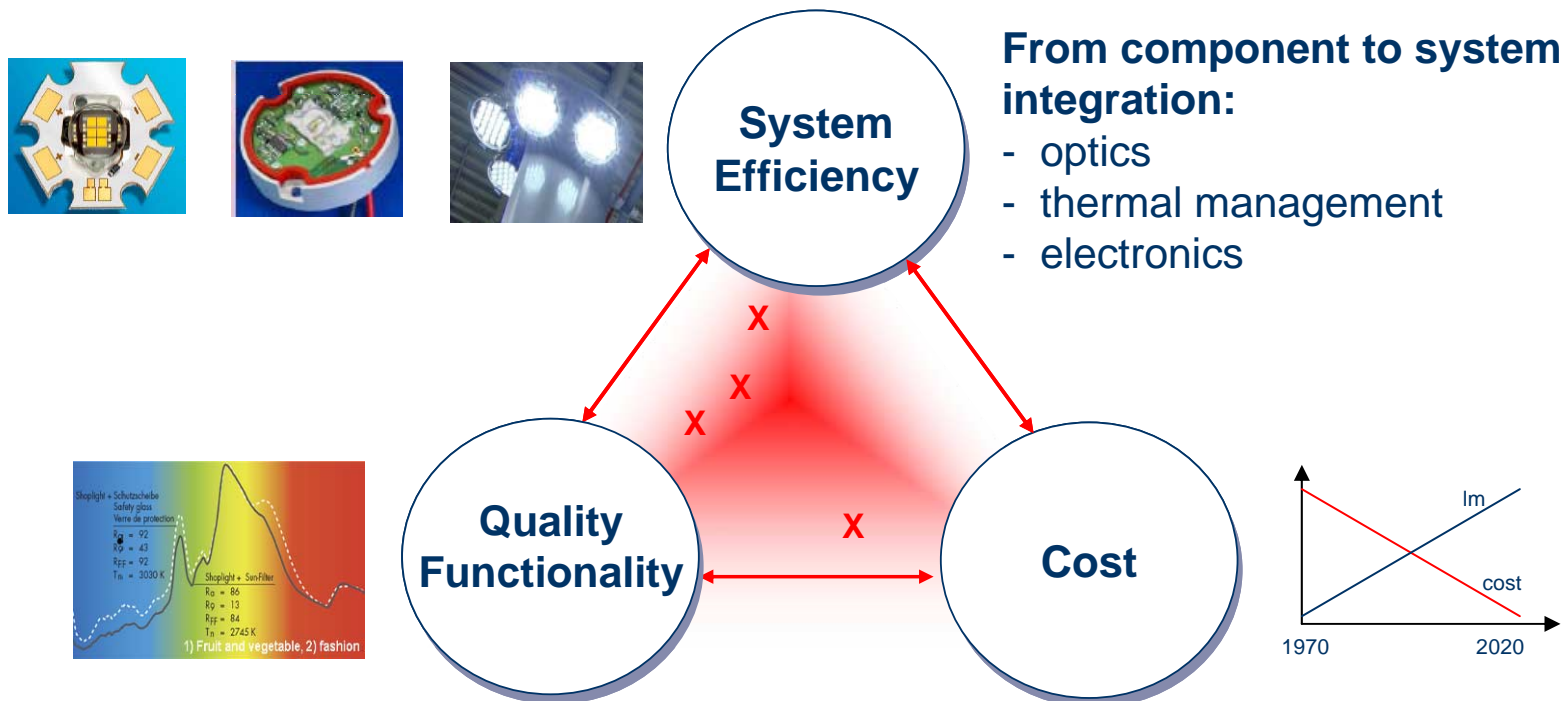
Phase out started 2009

Great prospects but big challenges as well

- Long lifetime all the way up to mount & forget will impact business models
 - Shift of lamp replacement market to initial investment.
 - Lamp & fixture differentiation becomes somewhat blurry
- TCO rather than initial cost will increasingly dominate the buying decisions
- Consumer awareness is changing. LED light is more than the function light. It's emotion, light comfort, systems & solutions....
- “Abilities” become key....
 - Reli-ability, interchange-ability, upgrade-ability, maintain-ability
- Guaranties gain even more importance, emergence of contracting
- Increasing competitive pressure on traditional manufacturers by new entrants from semiconductor & consumer electronics industry
- LED light will fuel full adoption of light management systems.
- Lighting design gets more options, from invisible, embedded...

What Needs to Be Addressed ?

LED is going to become the most efficient light generating device, but focused R&D effort mandatory to quickly exploit the potential



Highest quality white incl. excellent rendering
More intelligence (adaptable, tunable, connectable)

“more lm per Euro”

Four Steps to Exploit the Energy Savings Potential

LEDs are Compatible with Electronic Intelligence

Directional Light Confined to where it should be

**LIGHT
MANAGEMENT**

Minimize Losses in ECGs, Optics and Tj

**APPLICATION
EFFICIENCY**

In Case of PC-LEDs Efficiency Depends on CCT and CRI

**SYSTEMS
EFFICIENCY**

**LED
EFFICIENCY**

LED & Intelligent Light Management

Light can change the scenery



Make use of natural daylight



sensor types



= light detection



= motion / presence detection



= combi-sensors

- improves comfort and drastically reduces power consumption!
- mandatory for full exploitation of the energy savings potential of LEDs

Light is needed only if someone is present



Light creates emotion



LED is more than just Performance and Cost

This past January, we began adding an information box entitled "Metrics that Matter" to the end of our case study articles. The box provides some of the traditional, tangible measures of lighting design (watts per sq ft, footcandle levels, projected energy savings, etc.). In a subsequent letter to the editor, one reader recommended that we add even more metrics, such as a facility's actual energy consumption one year after occupancy.

As director of the Lighting Research Center at RPI, not to mention editor of the two most recent IES *Lighting Handbooks*, Prof. Mark Rea is most definitely a man of metrics. But in his thought-provoking keynote address on sustainability at the recent LightCongress 2008 conference in New York, Rea suggested adopting a few softer metrics that emphasize the "people side" of good lighting. "We're all slaves to lumens per watt," Rea said. "We need to have a more sophisticated discussion about sustainability; it's more than lumens." Rea argued for a new metric: "Benefit per watt should be the measure, not lumens per watt."

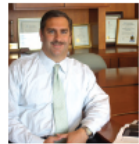
What are some of these benefits? Rea reeled off a few:

- "Sparkle per watt" in multi-function spaces such as hotel ballrooms and conference rooms that are continuously reset for different audiences.
- "Visual interest per watt" at attractions such as the Crown Fountain sculpture in Chicago's Millennium Park, where visitors flock to see an unusual water and light show.
- "Economic development per watt" where lighting can help revitalize central business districts or waterfront areas.

Rea's comments got me thinking, *How far can we take this "benefit per watt" thing?* I began jotting down a few more that building owners and designers might want to consider:

- In high-stress environments such as the DMV or airports, the metric could be "calm customers per watt."
- For romantic restaurants, we could track "marriage proposals per watt."
- In theaters, we can measure "encores per watt."
- In art galleries—or Porsche dealerships, for that matter—there's "oohs and ahs per watt."

If any of the above catch on, we're going to need a bigger metrics box. And for those who think *outside* the box when it comes to lumens per watt and watts per sq ft, that would be a welcome sight, indeed.



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emphasize the "people side" of good lighting !

"Sparkle per Watt."

"Visual interest per Watt."

"Economic development per Watt."

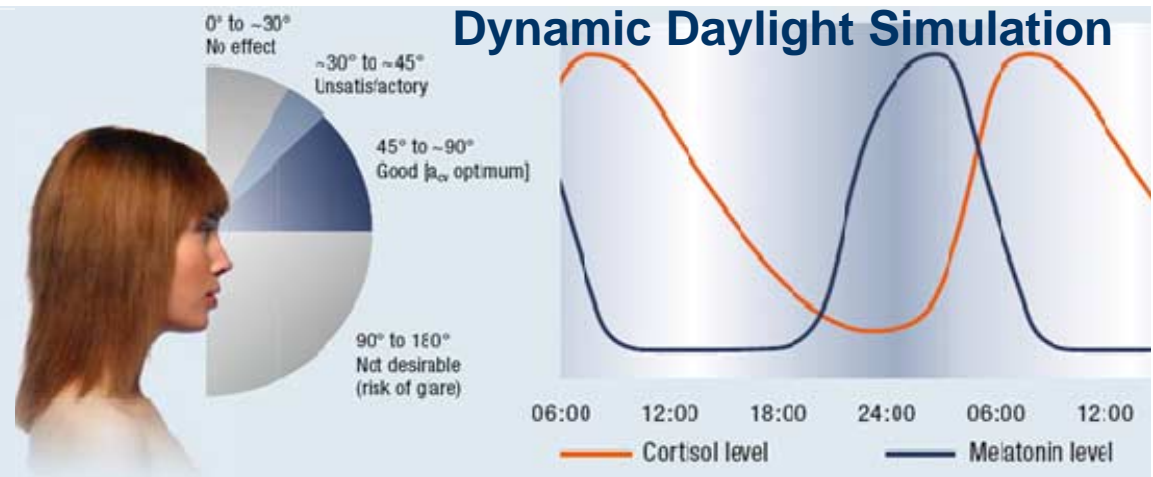
"Calm customers per Watt."

"Marriage proposals per Watt."

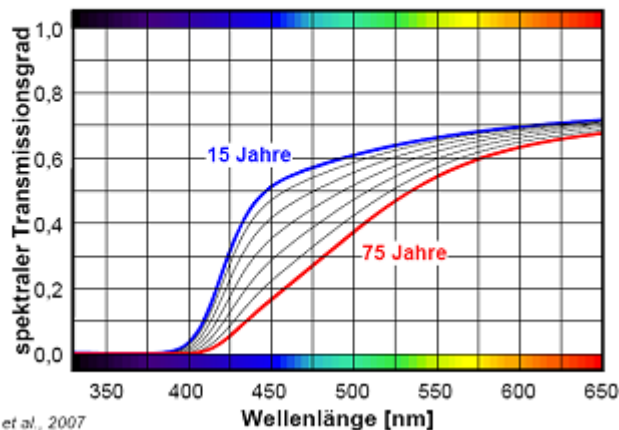
"Oohs and ahs per Watt."

"Benefit per Watt"

Color Quality is Key for Success in General Lighting



Transmissionsgrad des Auges
Altersabhängigkeit



van de Kraats et al., 2007

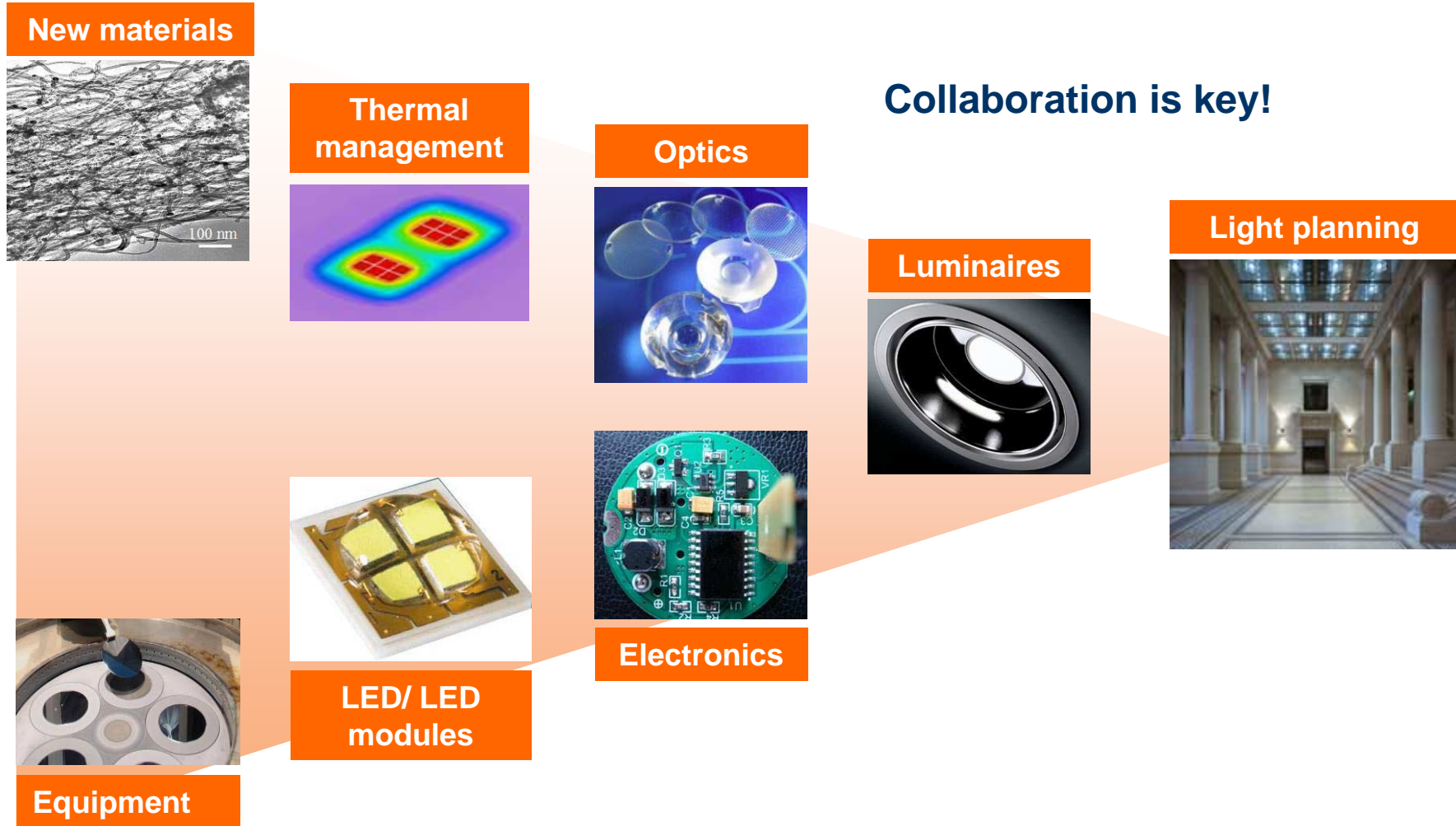
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Date: 23.03.2010 | Bernhard Stapp

Our biological clock has a strong influence on

- nocturnal sleep quality
- body core temperature and heart rate
- mood and well being
- alertness, cognition and reaction time
- performance and vigilance

Involves the Whole Value Chain

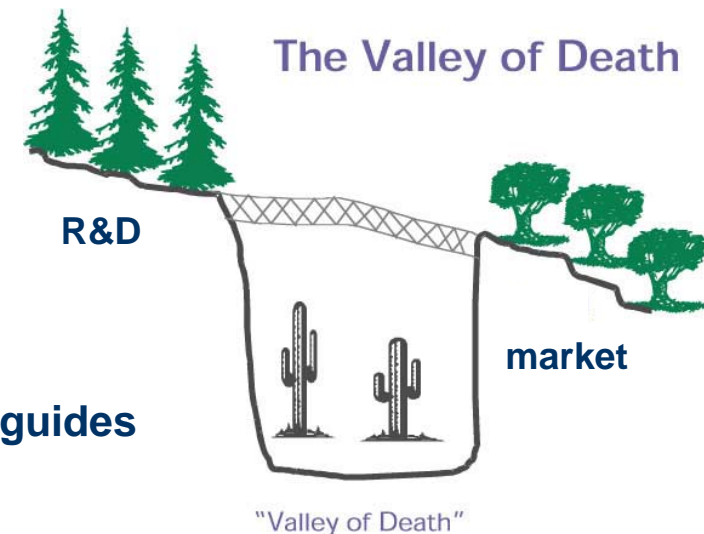


The Bridge of R&D to the Market

SSL – innovation barriers:

- More proof points needed for economic benefits
- Awareness & trust of end users in quality of light & energy savings
 - Quality label...
- More LED/electronics knowledge dissemination among the stakeholders
 - LED light planning, LED perception...
- More manufacturer independent information
- Compatibility with upgrades
- Interoperability & interchangeability not given
- Incentive- & financing-concepts to absorb higher initial cost
- User friendly planning, installation, maintenance guides
- Warranty models and their prerequisites

⇒ measures needed for market acceleration,
„LED-Leitmarktinitiative“ builds the bridge



Handlungsfelder

- Fokus-Änderung Allgemeinbeleuchtung
 - Von LED-Effizienz, Initialkosten, lm/€ zu Applikations-Effizienz, TCO
 - Von Produkt zu System-Optimierung
- Lichtqualität- und Lichtdynamik
- Die wichtigen Sekundär-Fähigkeiten:
 - Zuverlässigkeit, Upgrade-Fähigkeit, Wechselkompatibilität, Versorgungssicherheit
- LED-adaptierte Beleuchtung und Lichtlösungen, die erst die LED möglich macht
- Innovationsbarrieren und wie wir sie wegräumen können
- ...

... als Startpunkt für die Diskussion

